ANALOG DEVICES

AB-111
APPLICATION BRIEF

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Single-Supply Wien Bridge Oscillator

by James Wong

Wien bridge oscillators have the advantage of requiring only one op amp, and this advantage is particularly important for battery-operated applications. This oscillator circuit operates from a single 9V battery.

The conditions for Wien bridge oscillation are

$1 - R_1 R_2 C_1 C_2 \omega_O^2 = 0$ and

$$\frac{R_2 C_1}{R_1 C_1 + R_2 C_2 + R_2 C_1} = \beta$$

where β is the ratio of output voltage feedback to the inverting input. If $R_1 = R_2$ and $C_1 = C_2$, then ω_O is 1/RC and β is 1/3.

This oscillator should be set to just diverge in amplitude. Diodes are used to obtain a nonlinear feedback characteristic which will limit the divergence without causing too much distortion. The condition for oscillation is

$$\frac{R_3}{R_3 + 2\,(R_5 + R_4')} = \frac{1}{3}, \quad R_4' = \text{Parallel combination of } R_4 \text{ and diodes}$$

As a design example, consider

$C_1 = C_2 = 0.01\mu F$	$R_4 = 10k\Omega$
$R_1 = 15.8k\Omega$	$R_5 = 40k\Omega$ nominally
$2R_2 = 31.8$	Diodes = 1N914 or 1N4148
$R_3 = 50k\Omega$	$R_S = 1M\Omega$

Using these component values, f_O will be 1004Hz. Resistor R_5 must be adjusted for best amplitude stability. If R_5 is too low, the oscillation might converge; if too large, then the oscillation will diverge until the output clips. An oscillation output of 6V peak-to-peak when operating from a 9V battery is recommended. Resistor R_5 needs to be a nominal 40kΩ with a ±2.5kΩ adjustment range.

The OP-22 is operated with a 1MΩ set resistor for a set current of 7.8μA which corresponds to a supply current of approximately 100μA. Gain-bandwidth product and slew-rate vary directly with the set current, so R_S should be optimized for the specific oscillation frequency. Supply drain can be reduced for lower frequencies. The OP-22 works well for frequencies in the range of 100Hz to 1kHz; the OP-27 is recommended for higher frequencies.